Journal of Agricultural Technology 2014 Vol. 10(4): 1021-1037
Available online http://www.ijat-aatsea.com
ISSN 1686-9141

The effect of varieties, fertilizers, and cultivation methods on the production of lettuce (*Lactuca sativa* L.) under greenhouse conditions in Suriname

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Lydia V. Ori, Sadhana Debi-Tewarie, and Myrna Narain (2014) The effect of varieties, fertilizers, and cultivation methods on the production of lettuce (*Lactuca sativa* L.) under greenhouse conditions in Suriname. Journal of Agricultural Technology 10(4):1021-1037.

In Suriname, agricultural development still takes place in a traditional way. For strengthening and development of this sector, knowledge is the driving force. To achieve sustainable development of the sector, professionalization of the current production technology is essential. The sector needs to solve problems that affect the production adversely. It is known that the average farmer in Suriname can not afford research costs to improve production methods and efficiency on small vegetable farms in Suriname. In light of this, and given the fact that greenhouse cultivation in Suriname is still in its infancy stage, a study was undertaken to investigate lettuce production in the greenhouse. The aim of this study was to evaluate the effect of two fertilizers, two lettuce (*Lactuca* sativa *L.*) varieties, and two cultivation methods on lettuce production in the greenhouse. The parameters measured were plant height, number of leaves, leaf area, root length, root weight, fresh weight, productivity and soil analysis. The temperature and relative humidity were also recorded daily. The research findings reveal that the lettuce variety Mimosa has higher yields (2.89-3.49 kg/m^2) in comparison to Vera (2.87-339 kg/m$^{2)}$, regardless of method of cultivation and type of fertilizer used. Results also showed that lettuce produced in the unfertilized growth medium (control) was not significant different ($p < 0.05$) than the lettuce produced in the growth medium fertilized with NPK or chicken manure, due to the fact that the growth medium used contained enough organic fertilizers which were released slowly and were available for plant uptake. Lettuce production using the soil cultivated method significantly produced higher yields, in comparison to the sub-irrigated cultivated method of the PET bottles regardless cultivation method, variety or fertilizer.

Keywords: Lettuce production, protected agriculture humid tropics, PET bottles

Introduction

Suriname is a country with enormous agricultural potential. However, agricultural production still takes place in a traditional way. For strengthening and development of the agricultural sector, knowledge is the driving force

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while for sustainable development of the sector, professionalization is needed. However, as a result of the marginal income of farmers, they are unable to pay for research costs to find solutions for their agricultural problems in order to improve employ modern technology and improve efficiency in their farming activities.

According to the policy of the Ministry of Agriculture and Husbandry (LVV, 2012), the goal of the Surinamese Government is to increase sustainable agricultural production of vegetables and fruits for the local and export markets. However, the government recognizes that there is a need to address the issue of increase in vegetable production in Suriname which should involve the promotion of greenhouse cultivation, optimal land use, water efficiency, improvement of production technology, improving agricultural extension services (tillage, fertilization, pest harvest and post-harvest treatment), reduction of the cost of inputs, and finding new markets. Of the many agricultural crops, lettuce *(Lactuca sativa L.)*, is nowadays preferred for consumption in the Caribbean Islands and in Suriname. This opens a good market prospect, to CARICOM member countries especially since the export is free of customs tariffs (CSME, 2006). However, much more research must be done in advance to identify the market demand. The use of greenhouses in horticulture is not new in Suriname. There are different types of greenhouses used. It has been shown that soil fertility research of various lettuce varieties under optimal greenhouse conditions is needed (Chatterpal, 2003; Ori and Soetosenojo, 2003). During field visits to various vegetable growers in Suriname, it was reported that the farmers wanted to grow vegetables, preferably in a greenhouse, but that the majority of farmers cannot afford a simple greenhouse because of the high investment costs. The farmers know that the yield in protected cultivation conditions is significantly higher than when cultivated in the soil. It is also reported that that lettuce grows better in organic mediums (Chatterpal, 2003). Results have also indicated that the micro-climate inside the greenhouse influenced the growth conditions of lettuce.

In lieu of sustainable agriculture and the fact that greenhouse cultivation in Suriname is still in an infancy state, a study was conducted on the production of lettuce under greenhouse conditions. The aim of this study was to compare lettuce greenhouse production in terms of type of cultivation method and types of varieties and fertilizers used.

Materials and methods

The field experiment was conducted at the greenhouse at the Anton de Kom University of Suriname which is located behind building 7 at the university complex. This study was conducted from April 07-August 7, 2012. For this study, two different lettuce varieties (*Lactuca sativa var. Vera* en *Lactuca sativa var. Mimosa)* were used. Preliminary field visits were made to vegetable farmers who are known to grow lettuce in the fields. The reason for the field visits was to gather information on the cultivation systems, soil substrate used, and type of lettuce varieties.

Growth medium

Based on the field visits, a soil substrate was prepared having composition of shells, cow manure, and river sand in the ratio 2:1:1 and was used in the study. The bulk density of this substrate was 0.87 g/cm^3. From this medium five samples were drawn for analysis in the lab. The physical and chemical properties that were measured included pH, EC, Organic C, N_{Total}, P_{Total}, P-Bray, Exchangeable K, CEC, and soil texture (FAO, 2002).

Granulometric analysis was carried out by sieving and sedimentation (Robinson pipette)

The soil pH was measured in a potassium chloride solution (KCl). The Cation Eexchange Capacity (CEC) was determined with the Kjeldahl ammonia distillation technique. The tests of nonexchangeable potassium in soils were done with the tetraphenyl-boron-K precipitate method (TBK-method). The non-extractable phosphorus was decided by the spectrophotometer method, while plant-available phosphorus was determined by the Bray 2 method. The total nitrogen content of the soil was determined by the Kjeldahl method, and for the analysis of the organic matter content the Walkeley-Black method was used.

Lettuce leaves from all treatment combinations were cut from the lettuce plants, they were dried and milled and 3 samples of each were prepared for chemical analyses. From dry-ashed plant samples N, P, K was determined in two replications. The analyses were done at the Soil Science Laboratory of the Faculty of Technology of the University of Surname according to Jones (2001).

Table 1. Soil Analysis

Variables	Soil medium: (50 % shells, 25% river sand, and 25% cow manure)
pH	8.2
EC	3.91 Ms
Organic C	3.38 %
N-Total	0.21%
P –Total	0.31 %
P-Bray	42.9%
Exch. K	0.47 meq /100 g
CEC- unbuffered	5.14 meq /100 g
Texture	Sandy clay (37. 8% cl, 53.2 % s, 9.1% si) Shells: 45.2 %

On the basis of soil analysis and standard dosage, it was calculated how much fertilizer and organic manure needed to be added to the growth medium for optimal availability of the nutrients. The fertilizers used were NKP 15-15-15 granular and chicken manure grains 4-3-2.

Cultivated methods

Soil method

The plant density used for the plants in the medium was 25x25 cm. The size of a block was 150 cm x 300 cm (see photo 6). The blocks were filled with 15 cm medium. Each block was divided into six subplots. Each sub plot each had a size of 75 x 100 cm. The blocks were equipped with drip irrigation tubes that were connected to a timer coupled to a water tank. With the use of a timer the plants were watered five times a day.

Fig. 1a. Soil cultivation of transplants

Fig.1b. Three weeks old lettuce plants

PET bottles method

The plant density for the PET bottles was 15x15 cm. The size per sub-block was100 x 210 cm, while the dimension of a subplot was equal to 40 x 50 cm. The bottles were each filled with 0.5 dm ^{3} medium. There were special racks constructed to help keep the PET bottles in a stable place. These racks were made from waste wooden pallets constructed (Fig. 1c and 1d.).

Transplanting of lettuce plants for both methods took place on the same day. The experimental design was the same for both cultivation methods.

For PET bottles cultivation a total of 432 bottles 1.5 L needed. The PET bottles were cut in half (Fig 1e) and in each bottle with 3 holes were made. The holes were about 1 cm diameter and 2.5 cm apart. The function of the holes served for the inclusion of oxygen. Each bottle was fitted with cotton lint at the neck opening of the bottle. The cotton lint was in contact with the water in the lower half of the bottles, so that absorption of water was possible. The upper half of the bottles were filled with medium, in which the lettuce seedlings were transplanted later. The water in the lower half of the bottles served to irrigate the plants. There was only a single irrigation from above required during transplanting.

By capillary action, with the aid of the cotton ribbons, plants were watered. The required fertilizers were incorporated in the growth medium in advance.

Fig. 1c. Pet Bottles cultivation

Fig. 1d. Rack construction for the Pet Bottles

Experimental design

The experimental design of the field study was a Randomized Block design with a 2x3 factorial arrangement of 6 treatments combinations with 3 replications (Blocks). The two factors of the experiment included two lettuce

varieties: Mimosa and Vera, and two fertilizers and control (no fertilizer, NPK and chicken manure grains). Seeds of both lettuce varieties were sown in plant trays. These seeds germinated in 1-2 days and were be ready for transplanting 10-14 days after germination. They were grown in trays and then transplanted into the soil and planted using a plant spacing of 20x25 cm.

At transplanting stage, the plants were according to the treatment combination, not fertilized or fertilized with either NPK, or chicken manure. Fertilizer was applied 3 days before transplanting. Transplanting occurred at the 15^{th} day.

Observations

The plants were observed on a daily basis, and Temperature (T), and relative humidity (R.V) inside and outside the greenhouse were also registered daily. Length of leaves, height of plant, and number of leaves were measured and recorded on a weekly basis. Plant growth and incidences of diseases or pests were also daily observed. At harvest time, plant height, length of leaf, leaf area, plant weight, and root length and weight per treatment combination were measured. Soil analysis of the substrate and leaf analysis were also conducted.
All data obtained from the study were analyzed using the Analysis of variance (ANOVA) and the independent T-test.

Results

Temperature and Relative Humidity

The highest recorded temperature in the greenhouse was between 30-36 º C and that was between 11:00 am and 4:00 pm in the greenhouse. The maximum temperature in the greenhouse ADEK was 34.3º C. The minimum temperature was 23 º C which was between 2:00 am - 6:00 hours in the morning. According to Sanders (2001), the ideal temperature range for lettuce growth of lettuce ranges from 23-30ºC.

The results also showed that the highest relative humidity in the greenhouse fluctuated between 80-85% and that was between 10:00 pm-6:00 am in the greenhouse. The minimum relative humidity in the greenhouse at ADEK was 42% which was between 2:00 pm-3: 30 pm, and was associated with a temperature range between 33-34 ° C. The ideal range for the growth of lettuce is between 50-85% (Nederhoff, 1998).

Varieties (Vera versus Mimosa) effect on lettuce production

The results in Table 2 revealed that regardless of cultivation method, significant differences existed between the varieties in terms of the average number of leaves per plant. The variety Mimosa produced regardless type of fertilizers and cultivation method leaves than Vera. Looking at the findings in Table 2 for the PET bottles, it was obvious that there were significant differences between the two varieties ($p = 0.05$) in terms of average plant height. The Mimosa plants cultivated in the soil had a greater plant height, and were also significantly different ($p = 0.05$) from the Mimosa plants that used chicken manure and were cultivated in the soil.

Table 2. Average values of plant height, number of leaves, leaf area, and fresh weight of lettuce varieties

Method	Fertilizers	Varieties	Plant Height (cm)	Number of leaves (n)	Leaf area (cm^2)	Fresh weight (g)
Soil	Control	Vera	18.1 b	25b	210.7a	179.4a
		Mimosa	20.7a	29a	218.a	180.5a
	NPK	Vera	16.6a	24b	246.1a	174.1b
		Mimosa	16.8a	29a	229.7a	218.3a
	Chicken Manure	Vera	15.0 b	21b	308. 8a	211.7a
		Mimosa	20.9a	28a	235.9b	190.9a
Pet Bottles	Control	Vera	8.7b	15b	155.3a	51.7a
		Mimosa	14.8a	21a	145.1b	50.5a
	NPK	Vera	7.2b	16b	156.3b	63.1a
		Mimosa	9.8a	20a	188.9a	54.0b
	Chicken Manure	Vera	8.8b	16b	136.0b	57.6a
		Mimosa	12.0a	22a	176.0a	64.9a

[1]Mean of 6 replications. Means followed by a common letter in each column were significant different by LSD at p=0.05

The variety Vera, cultivated in soil, had a greater leaf area when using NPK fertilizer or chicken manure grains, while the Mimosa plants cultivated in the PET bottles variety had a larger leaf area for both the fertilized and unfertilized lettuce plants. Mimosa plants cultivated in soil with NPK fertilizer had a higher fresh weight in comparison to Vera plants cultivated in soil with chicken manure. For the PET bottles it was the other way: Vera had the highest fresh weight with NPK and Mimosa with chicken manure. Table 2 shows that regardless the method of cultivation, the varieties did not differ significantly in plant height, number of leaves, leaf area and fresh weight among the control (soil substrate without fertilizer), chicken manure, and NPK fertilizer.

Results also revealed that the variety Vera produced the same number of leaves (n=29) when the lettuce plants were cultivated in the soil without fertilizer or with chicken manure. Table 2 shows that the Mimosa planted in the soil with chicken manure had the largest plant height of 20.9 cm. It also can be seen that Vera has the largest plant height without fertilization. This indicates that even in a medium without fertilizer good results were obtained. The variety Mimosa had average root length of 19.5 cm which was obtained with the soil cultivation method and fertilized with NPK. The largest average root length for Vera was 17.3 cm which was obtained without fertilization (Fig. 2a).

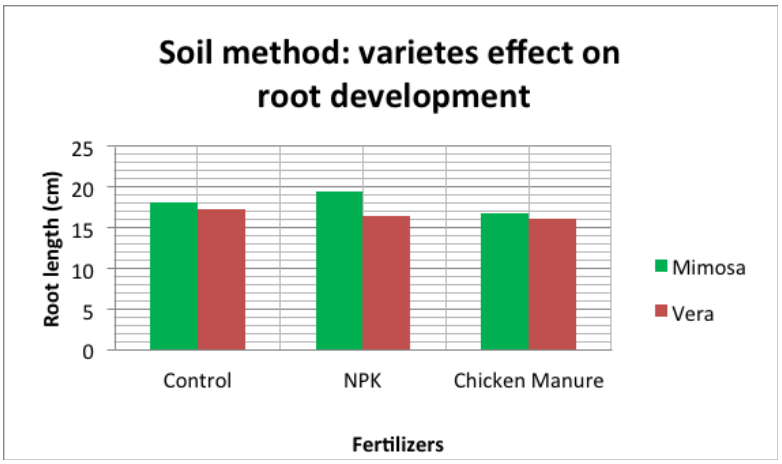

Fig. 2a. Varieties effect on the root length in the soil

Figure 2 b displays that the largest average root length (33.4 cm) for both varieties were similar. For variety Vera this is seen in the control treatment, while for the variety Mimosa this is the case with the NPK fertilizer. From Fig. 2b it is also noticed that the variety Vera in the PET-bottles had a larger root length in the control treatment in comparison to Mimosa.

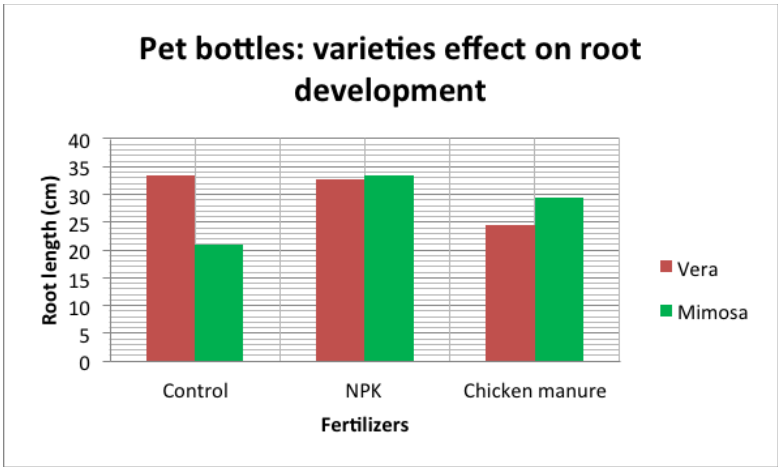

Fig. 2b. Varieties effect on the root length in pet bottles

Fertilizer effect (control, chicken manure and NPK) on lettuce production

Table 3 shows that the Mimosa variety cultivated in the soil were not significant (p = 0.05) different for type of fertilizers, number of leaves and leaf area. The variety Vera did show significant (p = 0.05) differences.

Table 3. Fertilizers effect on lettuce production

Varieties	Fertilizers	Plant height (cm)	Number of leaves (n)	Leaf area (cm^2)	Fresh weight (g)
Vera	Control	18.1a[1]	25a	210.7c	179.4a
	NPK	16.6b	21a	246.1b	174.1a
	Chicken manure	15.0c	24b	308.8a	211.7a
Mimosa	Control	20.7a	29a	218.8a	180.5b
	NPK	16.8b	29a	229.7a	218.3a
	Chicken manure	20.9a	28a	235.9a	190.9b
Vera	Control	8.7a	15b	155.3a	51.7a
	NPK	7.2a	16a	156.3a	63.1a
	Chicken manure	8.8a	16a	136.0a	57.6a
Mimosa	Control	14.8a	21a	145.1b	60.5a
	NPK	9.8c	20a	188.9a	54.0b
	Chicken manure	12.0b	22a	176.9a	64.9a

[1]Mean of 6 replications. Means followed by a common letter in each column were significant different by LSD at p=0.05

The unfertilized soil (control) had the highest average for the Vera plant height and the number of leaves produced, while with chicken manure the largest leaf area and fresh weight were produced. With the soil cultivation method, the Mimosa lettuce plants fertilized with chicken manure in the soil had the largest average plant height and leaf area, while Mimosa fertilized with NPK yielded the largest fresh weight. In the PET bottles, there were no significant differences (p= 0.05) between the effects of fertilizers for the variety Vera with regard to plant height, number of leaves leaf area and fresh weight. Differences for Mimosa were found in number of leaves and fresh weight between the unfertilized soil and chicken manure cultivated plants. The fertilizer NPK had regardless the variety, the largest average leaf area, but there are no significant differences between chicken manure and NPK in plant height P=0.05). The control Mimosa in PET bottles significantly better (p = 0.05) than the fertilized lettuce plants in bottles. In Table 3 it is also seen that using the soil cultivation method and the chicken manure grains, the variety Vera had the largest leaf area (308.8 cm ^{2}). From this table, it is also noticed that in terms of leaf surface there is no significant difference between the unfertilized soil and the fertilized soil with NPK plants. The highest average fresh weight (218.3g) with Mimosa while the variety Vera fertilized with chicken manure grains produced the highest average fresh weight (211.7 g).

The highest average root weight (5.2 g) was reported for the variety Mimosa with the control treatment in the soil. The Table also suggests that the root weights for all treatment combinations of the variety Mimosa were larger when compared to the root weights of the Vera plants (Fig. 2 c).

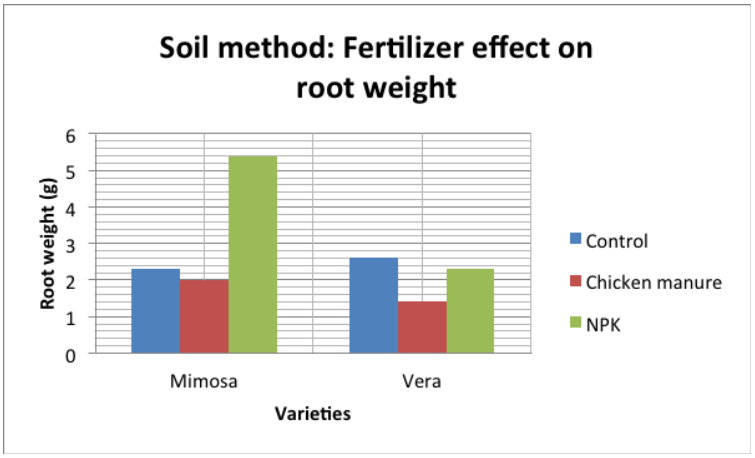

Fig. 2c: Average root weight *of varieties*

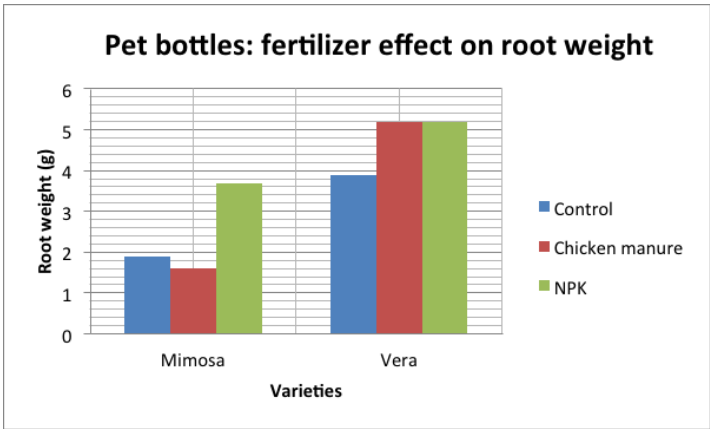

Fig. 2d. Fertilizer effect on root weight in pet bottles

Figure 2 d revealed that with the pet bottle cultivation method, Mimosa with NPK fertilization resulted in the highest root weight. It is further noticed that the variety Vera had the largest root weight in comparison to NPK fertilization and chicken manure grains.

Cultivation effect on lettuce production

Table 4 revealed that all lettuce plants cultivated in the soil, regardless plant height, number of leaves, leaf area, fresh weight, type of variety, and type of fertilizer were significant different ($p = 0.05$) than the lettuce plants cultivated in the PET bottles.

The lettuce plants cultivated in the soil, regardless the type of fertilizer or variety produced a much higher fresh weight, compared to the lettuce plants grown the PET bottles. Mimosa had the highest fresh weight (218.3g) obtained with NPK fertilizer, while Mimosa cultivated in PET bottles with chicken manure had highest fresh weight of 64.9 g (Table 4).

Table 4. Average values of parameters for cultivation methods

Varieties	Fertilizers	Methods	Plant Height (cm)	Number of Leaves	Leaf Area (cm^2)	Fresh weight (g)
Vera	Control	Soil	18.1a[1]	25a	210.7a	179.4a
	Control	Pet	8.7b	15b	155.3b	51.7b
	NPK	Soil	17.6a	24a	246.1a	174.1a
	NPK	Pet	7.20b	16b	156.3b	63.1b
	Chicken	Soil	15.0a	21a	308.8a	211.7a
		Pet	8.3b	16b	136.0b	56.6b
Vera	Control	Soil	20.7a	29a	218.8a	180.5a

	Control	Pet	14.8b	21b	145.1b	60.5b
	NPK	Soil	16.9a	29a	229.7a	218.3a
	NPK	Pet	9.8b	20b	138.9b	54.0b
	Chicken	Soil	20.9a	28.a	235.9a	190.9a
	Chicken	Pet	12.0b	22.b	176.9b	64.9b

[1] Mean of 6 replications. Means followed by a common letter in each column were significant different by LSD at p=0.05

The soil cultivated method and type of lettuce variety did not have an effect on the average number of leaves produced. The highest average numbers of leaves observed were in Mimosa with NPK fertilization (29), and the control Mimosa (29). In the PET bottles, Mimosa with chicken manure grains (22) had the highest average number of leaves (Table 4). The average leaf length for lettuce planted in the soil did not have any effect on type fertilizer or variety. The largest average mean leaf length (24.6 cm) was measured for the variety Vera, grown as a control in the soil. The average production per square meters was calculated for all six treatment combinations. According to literature, the production of organic lettuce grown is 23.2 tons per ha (Tourte *et al*., 2009) which corresponds to 2:32 kg per m². In the soil cultivation method 16 plants per m ² were planted with a plant density of 25x25 cm. With the PET bottles, 36 plants were cultivated per m² with a plant density of 15x15 cm. The medium required per plant in PET bottles was equal to 0.5 dm ³ and for the soil method equal to 9.38 dm ³ using the average fresh weight per variety per fertilizer the yield was calculated for each treatment. This is shown in Table 5.

Table 5. Average lettuce production per m^2 in the greenhouse

Method of cultivation	**Lettuce production (kg/m^2)**
Soil	
Control-Vera	2.87
Control-Mimosa	2.89
Chicken manure -Vera	3.39
Chicken manure -Mimosa	3.05
NPK-Vera	2.79
NPK-Mimosa	3.49
Pet Bottles	
Control-Vera	1.86
Control-Mimosa	2.18
Chicken manure -Vera	2.07
Chicken manures-mimosa	2.34
NPK-Vera	2.27
NPK-Mimosa	1.94

The Table indicates that production with the soil cultivated method exceeded the range (2.32 kg / m²) regardless of variety and fertilizer. Regarding

the Pet bottles, only the Mimosa lettuce production with the chicken manure grains fertilization was above the 2.32 kg / m².

Discussion

Microclimate in the greenhouse

According to Sanders (2001), the optimal temperature for the growth of lettuce under tropical conditions is between 22-30 ° C.

This means that the temperature in the greenhouse was far from ideal. The band width for optimal relative humidity for the growth of most plants is between 50-85 % (Nederhoff, 1998). The average maximum temperature in the greenhouse was higher than 30 °C between 11.00 am and 16.00 pm. The relative humidity in this period in the greenhouse ADEK was below 50%.

This leads to the conclusion that the lettuce production was negative influenced by this. If the growing conditions had been optimal in the greenhouse for temperature and relative humidity, the production would have been higher. The temperature in the greenhouse would have been even higher, if fans, a misting system and shadow mesh had not been used. Fans in the ADEK greenhouse were switched on a daily basis between 10.00 am and 5.00 pm on every half hour for 15 minutes for cooling down the greenhouse.

Despite the high temperatures between 11.00 am- 4.00 pm, optimal production in the greenhouse was achieved when planting lettuce in the soil. The yield of the soil cultivation method was within the range (2.32 kg fresh weight per m^2 (Tourte *et al*., 2009) in the greenhouse. With regard to the PET bottles, the desired optimal production (2.32 kg / m²) was not met, except for the Mimosa with fertilized with chicken manure, and the Vera plants with NPK fertilizer. It is plausible that the amount of growth medium available per plant in the PET bottles was a limiting factor for receiving lower production than the lettuce planted in the soil.

Effect of varieties (Vera and Mimosa) on lettuce production

The results revealed that the variety Mimosa produced significantly more leaves than the variety Vera, regardless the type fertilizers used, and the cultivation method used. Mimosa had also higher plant heights Also in plant height, regardless of fertilizers and cultivation method,. During the weekly observations it was also observed that the lettuce plants from the variety Mimosa were growing faster than the lettuce plants from the variety Vera.

Effect of soil (fertilized with chicken manure grains and NPK) on production

The results revealed no significant differences in the effect of soil medium used on the leaf area of plants grown in the greenhouse. There were no significant differences in the unfertilized growth medium on the leaf area of chicken manure grains and the NPK Mimosa variety grown in soil. The growth medium contained enough nutrients. The soil Analysis of the growth medium reported an N - content of 0.21 %, while according to the literature, an N - content of at least 3% is required for optimum production is Howard, M.,1983). However the yield of the medium was not below the range in the soil. This possibly may be attributed to that the soil medium contained enough organic nutrients readily available, that are released slowly (Sait and Yuksel, 2006).

Effect of cultivated method on production (soil method versus PET bottles)

The results revealed that the lettuce plants in the soil had a significantly higher average production in number of leaves, leaf area, fresh weight and plant height. The average root length in the PET bottles was better regardless the type of fertilizer or variety used. The yield with the soil cultivated method was higher than the optimal range (2.32 kg / m^2) while in the PET bottles the yield was below the range.

The high production obtained with the soil cultivation method can be explained by the larger plants spacing which was used (25x25 cm) when compared to the plants in the plastic bottles which had a plant spacing of 15x15cm. This provided the plants with more light and space available to grow. Plants get more sunlight with larger plant spacing, so there is less competition for sunlight and photosynthesis in the leaves. Optimal production is often obtained when an adequate plant density is applied when cultivation of crops (Cambodia Harvest, 2012).

Soil analysis and lettuce leaf nutrient analysis

The plant analysis (Table 5) showed that the plants were really healthy.

Table 5. Averages of N, P and K percentages in the harvested lettuce leaves

Treatment combinations	N(Nitrogen)	P	K (Potassium)

In the AdeKUS Greenhouse		(Phosphorous)	
Soil method			
Control -VERA	3.31	0.68	10.4
Control –MIMOSA	2.71	0.67	9.18
Control –VERA	2.81	0.65	2.98
Chicken manure -MIMOSA	2.83	0.67	9.38
NPK –VERA	3.12	0.47	9.19
NPK –MIMOSA	3.30	0.67	7.94
PET Bottles			
Control -VERA	2.57	0.65	10.23
Control –MIMOSA	3.57	0.74	9.35
Chicken manure –VERA	2.72	0.72	8.70
Chicken manure -MIMOSA	2.52	0.60	8.37
NPK –VERA	2.99	0.72	10.40
NPK –MIMOSA	2.86	0.81	10.40

The lettuce plants requirements were within the range for the N, P and K contents (Table 6) were in the range of nutrients range of a healthy lettuce plant after the harvest (Howard, M, 1983). This was expected because the amount of nutrients needed for optimal growth, were pre- calculated and mixed with the soil to make sure that no nutrient deficiency would occur.

Table 6. Nutrients range of a healthy lettuce plant after the harvest

Nutrients	Range
N	3.0 – 6.0 %
P	0.8 – 1.3 %
K	5.0 – 10.8 %

(Howard, 1983)

Conclusion

From this study it can be concluded that

Despite extra amenities (shade cloth, misting system and fans) in the greenhouse, it was still not possible to reach optimum temperatures between 11:00 am – 4:00 pm.

The average high temperature in the greenhouse from 11:00 am -4.00pm resulted in a low relative humidity (<50 %) in the ADEK greenhouse.

The lettuce Mimosa produced higher yields in comparison to the variety Vera, regardless the soil medium, and cultivation method.

There were no significant differences in the effect of soil medium used on the production, regardless the variety, and cultivation method. The unfertilized

soil medium produced equally good production results in comparison to the fertilized soils. This suggests that no additional fertilization is required for a good organic soil.

The soil cultivation method yielded a significantly higher production than the PET bottles cultivation method, regardless variety and type of fertilizer.

With the soil cultivation method optimal production was reached per m^2 cultivation area.

In the case of the PET bottles, the yield per m^2 was lower, but with relatively less soil (medium) used, about eight times cheaper. Moreover, the investment in PET bottles cultivation was lower than that in the soil cultivation method.

The PET bottles cultivation method, if applied on a larger scale, can make a substantial contribution to the solution of the problem of thousands of plastic bottles that are found in Suriname as litter everywhere.

Acknowledgements

The authors want to thank the University of Suriname, Faculty of Technology (FTeW) for their support to carry out this study as part of the Protected Agriculture Research program at the Department of Agricultural Production. The authors also want to acknowledge the Soil Science Laboratory from the FTeW for their assistance with the soil and leaf samples, and Mr. S. Oosthuizen from the Inter American Institute for Cooperation on Agriculture (IICA) for his practical expertise on greenhouses.

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(Received 24 May 2014; accepted 30 June 2014)